IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	: Michael C. Kautzky	Appeal No.
Appln. No.	: 10/668,437	Confirmation No.: 2388
Filed	: September 23, 2003	Group Art Unit: 2627
Title	: MAGNETIC SENSOR WITH ADJUSTABLE ELECTRICAL DIMENSIONS	Examiner: David Donald Davis
Docket No.	: I69.12-0593	

BRIEF FOR APPELLANT (SUBSTITUTE)

SENT VIA EFS-WEB

Commissioner For Patents
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This is an appeal from an Office Action dated May 12, 2008 in which claims 1, 3-8, 10-13, 15, 16, and 27-29 were finally rejected and claim 14 was objected to but indicated as allowable if rewritten in independent form. Oral hearing is not requested.

Contents

Real Party in Interest

The real party in interest is Seagate Technology LLC, which is the owner of the entire right, title and interest in the application.

Related Appeals and Interferences

There are no known related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

Status of the Claims

I. Total number of claims in the application

Claims in the application are:	1, 3-8, 10-24, and 27-29, inclusive.

II. Status of all the claims

A.	Claims cancelled:	2, 9, 25, and 26.
B.	Claims withdrawn but not cancelled:	17-24.
C.	Claims pending:	1, 3-8, 10-16, and 27-29.
D.	Claims allowed:	None.
E.	Claims objected to:	14.
F.	Claims rejected:	1, 3-8, 10-13, 15, 16, and 27-29.

III. Claims on appeal

A.	The claims on appeal are:	1, 3-8, 10-16, and 27-29.

Status of Amendments

No amendment has been filed subsequent to the final rejection of the claims.

Summary of the Claimed Subject Matter

The invention, as recited in each of the independent claims, is directed to a magnetic sensor (independent claims 1 and 27) or a magnetoresistive read head (claim 11) in which an electric field E is applied in a direction generally transverse to the direction in which sense current I_s flows through a sensor stack (claims 1 and 27) or a magnetoresistive stack (claim 11) (e.g., 12, 32, 62, 72, 100). The electric field E reduces the area through which sense current I_s can flow--i.e. it confines

the sense current I_s to a smaller area than the physical area of the stack. Depending upon the orientation of the electric field, the electrical width w_e of the stack (i.e., the width of the stack through which sense current can flow) can be made smaller than the physical width w_p of the stack, or the electrical stripe height h_e of the stack can be made smaller than the physical stripe height h_p. Making the electrical width w_e smaller increases resolution of the magnetic sensor or magnetic read head. Reducing the electrical stripe height h_e increases the sensitivity of the magnetic sensor or magnetic read head.

Claim 1 defines a magnetic sensor 1(e.g., 10 in FIG. 1a, 30 in FIG. 1b) having a physical width w_p and a corresponding electrical width w_e and has a physical height or stripe height h_p and a corresponding electrical height h_e. The magnetic sensor also includes means (14, 16 in FIG. 1a; 34, 36, 37 in FIG. 1b) generating an electric field E in a direction generally transverse to a direction of flow of sense current I_s through sensor stack (12 in FIG. 1a, 32 in FIG. 1b) to create a charge carrier depleted region in the sensor stack. Examples of charge carrier depleted regions are shown as regions 58 in FIG. 2a, regions 68 in FIG. 2b, and regions 78 in FIG. 2c. The charge carrier depleted regions also can be seen in FIGS. 1a and 1b as the portions of the physical width w_p that are outside of the electrical width w_e and the portions of the physical height h_p that are outside of the electrical height h_e.

The charge carrier depleted region or regions in the sensor stack (12, 32) created by the electrical field cause at least one of (a) the electrical width w_e to be smaller than the physical width w_p or (b) the electrical height h_e to be smaller than the physical height h_p. FIGS. 1a, 1b, 2a-2c, 5a and 5b all show electrical width w_e smaller than physical width w_p. FIG. 1b also shows an embodiment in which electrical height h_e is smaller than the physical height h_p.

Independent claim 11 recites a magnetoresistive read head (e.g., 10 in FIG. 1a) comprising a magnetoresistive stack (12) and a first bias electrode (14 or 16). The first bias electrode (14, 16) is positioned with respect to magnetoresistive stack (12) to generate an electric field E in a direction generally transverse to the direction of sense current I_s flow through the sensor stack (12), such that a read width w_e of the magnetoresistive stack (12) is a function of the bias voltage V applied to the first bias electrode (14, 16).

Independent claim 27 recites a magnetic sensor (e.g., 10 in FIG. 1a) comprising a sensor stack (12) and at least one electrode (14, 16) configured to generate an electric field E generally perpendicular to a direction of sense current I_s flow through the sensor stack (12) to produce a charge carrier depleted region (the portions of physical width w_p that are outside of the electrical width w_e). The charge carrier depleted region in magnetic sensor (10) confines the sense current I_s to a smaller area in magnetic sensor (10). In other words, sense current I_s is confined in the width direction to the portion of stack (12) defined by electrical width w_e, this is smaller than the physical width w_p.

Grounds of Rejection to be Reviewed on Appeal

Does Kadokawa anticipate claims 1, 3, 10-13, 15 and 16 or render obvious claims 4-6 and 27-29, when the claims require generating an <u>electric</u> field generally <u>perpendicular</u> (or <u>transverse</u>) to the direction of sense current through a magnetoresistive stack to reduce the effective width (or height) of the stack, while Kadokawa teaches generating a <u>magnetic</u> field generally <u>parallel</u> to the direction of sense current through a magnetic resistance film to reduce the effective width of the film?

Argument

In the Final Office Action dated May 12, 2008, claims 1, 3, 10-13, 15, and 16 were rejected under 35 U.S.C. § 102(e) as being anticipated by Kadokawa (U.S. Patent No. 6,661,627). Claims 4-6 and 27-29 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kadokawa. Claim 14 was objected to as being dependent upon a rejected base claim but indicated as allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 17-24, which had been subject to a species election earlier in prosecution of the application, remain withdrawn.

In a response filed August 6, 2008, Applicant requested that finality of the Office Action be withdrawn pursuant to M.P.E.P. § 706.07(c) as being premature. Applicant also responded to the rejection of claims 1, 3-8, 10-13, 15, 16, and 27-29.

In an Advisory Action dated October 21, 2008, the Examiner entered the response, but did not address the request to withdraw the finality of the objection. The Advisory Action stated:

"The request for reconsideration has been considered but does NOT place the application in condition for allowance because: the rejection of record is maintained."

1. Description of Reference Relied on by the Examiner

The Office Action dated May 12, 2008 relies on only one reference: U.S. Patent No. 6,661,627 by Kouichi Kadokawa entitled "Magnetic Recording Device, Method of Adjusting Magnetic Head, and Magnetic Recording Medium" ("Kadokawa"). A copy of Kadokawa is provided in the Evidence Appendix.

FIGS. 2 and 5 of Kadokawa show the magnetic sensing part of a magnetic head, which includes magnetic resistance film 1, electrodes 2, hard magnetic film 3, solenoid 4, and current generating circuit 5, which is disposed in or near preamplifier 6. (Kadokawa, col. 4, lines 31-50).

> A fixed magnetic recording device which can suppress dispersions appearing, upon manufacturing, on an effective track width and a longitudinal bias magnetic field of a magnetic head using a hard bias system. A magnetic recording device, which includes a magnetic head using a hard bias system, the head having a hard magnetic film (3) for adding a magnetic field in a longitudinal bias direction to a magnetic resistance film (1) and for controlling a magnetic domain, is characterized in that the hard magnetic film (3) includes a solenoid (4) for adjusting a magnetic field running in a longitudinal bias direction. Thus, it is possible to make fine adjustments on a magnetic field in a longitudinal bias direction and to maintain an optimum value. Consequently, it is possible to improve the linear response of a reproducing output of the magnetic head and to adjust an effective track width of the magnetic head.

(Kadokawa, Abstract).

Magnetic resistance film 1 may be a magnetoresistive film or a spin valve film. Magnetic resistance film 1 detects a change of a magnetic field from the magnetic recording medium. (Kadokawa, col. 4, lines 31-36). Electrodes 2 are located on opposite sides of magnetic resistance film 1. The structure shown in FIGS. 2 and 5 is a "current in-plane" type magnetoresistive sensor, in which a sense current flows from one of the electrodes through the magnetic resistance

film to the other electrode in a direction that is generally parallel to the top and bottom plane of film 1. The sense current is maintained constant, so that as the resistance of film 1 changes as a function of the sensed magnetic field, the voltage between the two electrodes changes.

Hard magnetic film 3 is positioned below electrodes 2 on opposite sides of magnetic resistance film 1. Hard magnetic film 3 acts as a magnetic bias to bias the magnetization direction of magnetic resistance film 1. Kadokawa states that NiFe is often used for magnetic resistance film 1, and that a material such as CoCrPt is often used as the hard magnetic film 3. (Kadokawa, col. 4, lines 40-43). The bias produced by hard magnetic films 3 is a longitudinal bias in the direction parallel to the top and bottom surfaces of magnetic resistance film 1. (Kadokawa, col. 4, lines 36-40).

Solenoid 4 is wound around hard magnetic film 3. (Kadokawa, col. 4, lines 44-47). By directing current through the coils of solenoid 4, a magnetic field can be generated that either adds to or subtracts from the magnetic field generated by the hard magnetic film 3. (Kadokawa, col. 5, lines 24-31; col. 3, lines 13-35). The longitudinal bias field generated by hard magnetic film 3 applies a magnetic field in the longitudinal direction to film 1 to suppress Barkhausen noise (which is produced by sudden changes in size or orientation of ferromagnetic domains within film 1). (Kadokawa, col. 4, lines 36-40).

Kadokawa suggests that the magnetic field generated by solenoid 4 can be used to adjust the track width of the magnetic head. Kadokawa states:

> As shown in FIG. 5, a magnetic resistance film 1 in the vicinity of the hard magnetic film 3 actually includes a reproducing film inert region 9, which cannot function as a reproducing sensor because of the influence of magnetism from the hard magnetic film 3 (a spindle film in some cases). An effective track width is narrowed because the reproducing film inert region 9 cannot function as a sensor.
>
> For this reason, the following operation is suitably performed by using the wiring pattern 7 to bring an effective track value to a design value. Namely, an effective track width of the reproducing head B is measured by the measuring section, a difference between a measured value and a design value is computed by the computing and determining section to determine an optimum current value, and

> current is adjusted by the current adjusting section to obtain a determined current value.
>
> Namely, when an effective track width needs to be smaller, current is applied to the solenoid 4 to increase the reproducing film inert region 9. When an effective track width needs to be larger, reverse current is applied to the solenoid 4 to decrease the reproducing film inert region 9.
>
> The above operation makes it possible to modify an effective track width close to a design value. An effective track width is varied due to dispersions in size or the like caused during manufacturing and due to the influence of a skew angle, a head flying height or the like.

(Kadokawa, col. 5, line 59 to col. 6, line 17).

2. Rejection of Claims 1, 3, 10-13, 15, and 16

In the Office Action, claims 1, 3, 10-13, 15, 16 were rejected under 35 U.S.C. 102(e) as being anticipated by Kadokawa US Patent 6,661,627.

Independent claim 1 reads as follows:

1. A magnetic sensor comprising:

a sensor stack having a physical width with a corresponding electrical width and a physical height with a corresponding electrical height; and

means for generating an electric field in a direction generally transverse to a direction of sense current flow through the sensor stack to create a charge carrier depleted region in the sensor stack such that at least one of (a) the electrical width is smaller than the physical width and (b) the electrical height is smaller than the physical height.

Independent claim 1 defines a magnetic sensor having a sensor stack and means for generating an <u>electric field</u> in a direction generally <u>transverse to a direction of sense current flow</u> through the sensor stack to create <u>a charge carrier depleted region</u> in the sensor stack such that at least one of (a) the electrical width is smaller than the physical width and (b) the electrical height is smaller than the physical height.

With respect to claim 1, the Office Action states: "Kadokawa shows in figure 3 an arrangement for providing generating an electric field in a direction generally transverse to a direction of sense current flow through a sensor stack 1 to create a charge carrier depleted region in the sensor stack such that at least one of (a) the electrical width 9 is smaller than the physical width and (b) the electric height is smaller than the physical height."

Element "3" shown in FIGS. 2 and 5 of Kadokawa is identified as a hard magnetic film, not an electrode. It is element 2 that is referred to by Kadokawa as an electrode, but not as a "bias electrode" as required by claim 1. Further, in FIG. 2, reference numeral 1 denotes a magnetic resistance film (an MR film or a spin valve film) which detects a change of a magnetic field from the magnetic recording medium and obtains a reproducing output, reference numeral 2 denotes an electrode for transmitting a signal of the magnetic resistance film 1, and reference numeral 3 denotes a hard magnetic film which is disposed on both ends of the magnetic resistance film 1 along its longitudinal direction and applies a magnetic field in its longitudinal direction to suppress Barkhausen noise. A material such as NiFe is often used for the magnetic resistance film 1, and a material such as CoCrPt is often used for the hard magnetic film 3.

Kadokawa does not use hard magnetic layers 3 to apply an <u>electric field</u> to sensor stack 1 to narrow the track width, as claimed. Rather, as shown in FIG. 5, claim 1 requires means for generating an <u>electric field</u> in a direction generally <u>transverse</u> to a direction of sense current flow. In contrast, Kadokawa uses coils 4 to generate a <u>magnetic field</u> is a <u>longitudinal direction parallel to current flow</u>. Current from current generating circuit 5 is delivered through solenoid coils 4 to the two magnetic films 3 located on opposing sides of sensor stack 1. The current applied to solenoid 4 generates a <u>magnetic</u> flux in a longitudinal direction of hard magnetic film 3 to adjust the longitudinal bias magnetic field that is applied by hard magnetic film 3 to sensor stack 1.

A magnetic field is not the same as an electric field. Nor is a current applied to a solenoid the same as a voltage applied to a bias electrode.

Furthermore, the element that Kadokawa identifies as an electrode (element 2) is not used to apply an electric field that creates a charge carrier depleted region in the sensor stack. As stated by Kadokawa at column 4, lines 35-36, reference numeral 2 denotes an electrode "for

transmitting a signal of the magnetic resistance film 1." Given the positioning of electrodes 2 on opposite sides of stack 1, Kadokawa is showing a current-in-plane (CIP) type sensor stack in which the current flows from one electrode 2 in a generally longitudinal or horizontal direction through sensor stack 1 to the other electrode located on the opposite side of sensor stack 1. Thus, the sense current flowing through stack 1 is in the same direction as the magnetic field being applied in the longitudinal direction by solenoid coils 4 and hard magnetic films 3.

The voltage that appears between electrodes 2 in Kadokawa is not a bias voltage. Rather, it is the output voltage V_o of the sensor, which is equal to the sense current I_S times the resistance R of the sensor ($V_o=I_SR$). The sense current is constant and the resistance of magnetic resistance film 1 changes as a function of the magnetic field being sensed. The electric field associated with the output voltage between electrodes 2 is in the same direction (i.e. parallel to) as the sense current—not transverse to the direction of sense current flow as required by claim 1.

Therefore, Kadokawa fails to disclose the present invention, as defined in independent claim 1 for several reasons. First, it does not generate an electric field that creates a charge carrier depleted region in the sensor stack. Instead, Kadokawa generates a magnetic field to create a magnetic inert region. Second, it does not generate an electric field in a direction generally transverse to a direction of sense current flow through the sensor stack. Even if the magnetic field of Kadokawa were instead an electric field, it is in the same direction as the sense current flow between electrodes 2 located on opposite sides of sensor stack 1- - not generally transverse to the direction of sense current flow as currently claimed. Furthermore, the output voltage and electric field produced by sense current flowing through magnetic film are parallel to the direction of the sense current—not transverse.

Dependent claim 3 further states that the means for providing an electric field comprises two bias electrodes disposed on opposing sides of the sensor stack such that the electrical width of the sensor stack is a function of a bias voltage applied to the two bias electrodes. With respect to claim 3, the Office Action states: "the arrangement for providing an electric field comprises two bias electrodes 3 disposed on opposing sides of the sensor stack 1 such that the electrical width 9 of the sensor stack 1 is a function of a bias voltage applied to the two bias

electrodes 3". As discussed above with respect to claim 1, the voltage appearing between electrodes 2 (and between hard magnetic films 3) is not a bias voltage. Instead, it is an output voltage created by the flow of the sense current through magnetic resistance film 1.

Dependent claim 10 states that the means for providing an electric field comprises a bias electrode positioned such that the electrical height of the sensor stack is a function of a bias voltage applied to the bias electrode. With respect to claim 10, the Office Action again refers to "bias electrode 3" of Kadokawa. As discussed above, Kadokawa does not disclose bias electrodes or, a bias voltage. Nor does Kadokawa disclose controlling electrical height of a sensor (either by an electric field or a magnetic field).

Independent claim 11 reads as follows:

11. A magnetoresistive read head comprising:

a magnetoresistive stack; and

a first bias electrode positioned with respect to the magnetoresistive stack to generate an electric field in a direction generally transverse to a direction of sense current flow through the sensor stack such that a read width of the magnetoresistive stack is a function of a bias voltage applied to the first bias electrode.

The arguments in the Office Action with respect to independent claim 11 and dependent claims 13, 15, and 16 fail for the same reasons. Kadokawa does not teach generation of an electric field in a direction generally transverse to direction of sense current flow through the sensor stack, and does not teach the use of an electric field to create a charge carrier depleted region in order to create an electrical width (i.e. read width) that is smaller than the physical width. Kadokawa reduces track width (i.e. read width) with a magnetic field parallel to the direction of sense current flow. The structure and the physical effect used by Kadokawa is different than the invention defined in claims 11, 13, 15, and 16.

Claims 1, 3, 10-13, 15, and 16 are not anticipated by Kadokawa. The rejection under 35 U.S.C. § 102(e) should be reconsidered and withdrawn.

3. Rejection of Claims 4-6 and 27-29

Claims 4-6 and 27-29 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kadokawa. Claims 4-6 depend from independent claim 1. As previous discussed, Kadokawa does not teach or suggest the invention, as defined in independent claim 1, or dependent claim 3. The rejection of claims 4-6 should be reconsidered and withdrawn.

Independent claim 27 reads as follows:

27. (Previously presented) A magnetic sensor comprising:

a sensor stack; and

at least one electrode configured to generate an electric field generally perpendicular to a direction of sense current flow through the sensor stack to produce a charge carrier-depleted region in the magnetic sensor that confines the sense current to a smaller area in the magnetic sensor.

Independent claim 27 defines a magnetic sensor having a sensor stack and having at least one electrode configured to generate an electric field generally perpendicular to the direction of sense current flow through the sensor stack to produce a charge carrier depleted region in the magnetic sensor that confines the sense current to a smaller area in the magnetic sensor. Dependent claims 28 and 29 depend from independent claim 27.

Kadokawa does not teach or suggest the subject matter of claim 27 or dependent claims 28 and 29 for several reasons, which have been discussed in detail with respect to claims 1 and 11. First, Kadokawa does not generate an electric field to adjust track width. Rather, it generates a magnetic field (with coils 4).

Second, Kadokawa does not generate a field (either magnetic or electric) generally perpendicular (or transverse) to the direction of sense current flow. In fact, the magnetic field generated by Kadokawa is in the same direction as the sense current flow through magnetic film 1.

Third, Kadokawa does not teach the creation of a charge carrier depleted region in the magnetic sensor. This charge carrier depleted region is an <u>electrical</u> phenomenon created by an electric field. Kadokawa shows the use of solenoids and hard magnetic films to create magnetic fields that result in an "inert region 9" that cannot function as a sensor because of the influence of the

magnetic fields (Kadokawa, col. 5, lines 59-65). The inert region is magnetically inactive, but it is electrically active--the sense current flows in the longitudinal direction between electrodes 2 through inert regions 9. Kadokawa does not teach the use of an electric field to create a charge carrier depleted region in the magnetic sensor.

Fourth, Kadokawa does not teach confining the sense current to a smaller area. Rather, Kadokawa flows the sense current through the entire width of magnetic film 1 from electrode 2 on the left side to electrode 2 on the right side. The reduced track width is the result of a magnetic field created inert region that is magnetically inactive or "inert", not current confinement by an electric field induced charge carrier depleted region.

Independent claim 27 and dependent claims 28 and 29 are neither taught nor suggested by Kadokawa. The rejection under 35 U.S.C. § 103(a) should be withdrawn.

4. Objection to Claim 14

The Office Action objected to claim 14 as being dependent from a rejected base claim. It indicated that claim 14 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claim 14 depends from independent claim 11 through dependent claims 12 and 13. Because claim 11 as well as claims 12 and 13 are in condition for allowance, claim 14 is as well.

5. Withdrawn Claims 17-24

Claims 17-24 all depend directly or indirectly from independent claim 11. These claims have been indicated as withdrawn. However, because independent 11 is in condition for allowance, claims 17-24 are also in condition for allowance. The status of those claims should be changed and they should be allowed.

CONCLUSION

In view of the foregoing, it is respectfully requested that the rejections of claims 1, 3-8, 10-13, 15, 16, and 27-29 be reversed, and that pending claims 1, 3-8, 10-24, and 27-29 be allowed.

Respectfully submitted,

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Claims Appendix

1. (Previously presented) A magnetic sensor comprising:

a sensor stack having a physical width with a corresponding electrical width and a physical height with a corresponding electrical height; and

means for generating an electric field in a direction generally transverse to a direction of sense current flow through the sensor stack to create a charge carrier depleted region in the sensor stack such that at least one of (a) the electrical width is smaller than the physical width and (b) the electrical height is smaller than the physical height.

2. (Canceled)

3. (Previously presented) The magnetic sensor of claim 1, wherein the means for providing an electric field comprises two bias electrodes disposed on opposing sides of the sensor stack such that the electrical width of the sensor stack is a function of a bias voltage applied to the two bias electrodes.

4. (Original) The magnetic sensor of claim 3, wherein the two bias electrodes are biased with negative DC bias voltages.

5. (Original) The magnetic sensor of claim 3, wherein the two bias electrodes are biased with positive DC bias voltages.

6. (Original) The magnetic sensor of claim 3, wherein the two bias electrodes are biased with an AC bias voltage.

7. (Original) The magnetic sensor of claim 3, wherein the two bias electrodes are biased with bias voltages of opposite polarity.

8. (Previously presented) The magnetic sensor of claim 1, wherein the means for providing an electric field comprises a bias electrode disposed on a side of the sensor stack such that the electrical width of the sensor stack is a function of a voltage of the bias electrode.

9. (Canceled)

10. (Previously presented) The magnetic sensor of claim 1, wherein the means for providing an electric field comprises a bias electrode positioned such that the electrical height of the sensor stack is a function of a bias voltage applied to the bias electrode.

11. (Previously presented) A magnetoresistive read head comprising:

a magnetoresistive stack; and

a first bias electrode positioned with respect to the magnetoresistive stack to generate an electric field in a direction generally transverse to a direction of sense current flow through the sensor stack such that a read width of the magnetoresistive stack is a function of a bias voltage applied to the first bias electrode.

12. (Original) The magnetoresistive read head of claim 11, wherein the first bias electrode is disposed on a side of the magnetoresistive stack.

13. (Original) The magnetoresistive read head of claim 12, further comprising:

a second bias electrode disposed on a side of the magnetoresistive stack opposite the first bias electrode, the first and second bias electrodes each providing a voltage.

14. (Previously presented) The magnetoresistive read head of claim 13, further comprising

a third bias electrode positioned such that an electrical stripe height of the magnetoresistive stack is a function of a bias voltage applied to the third bias electrode.

15. (Original) The magnetoresistive read head of claim 12, further comprising:

a second bias electrode disposed on a side of the magnetoresistive stack opposite the first bias electrode, the second bias electrode having a bias voltage of opposite polarity to a bias voltage applied to the first bias electrode.

16. (Previously presented) The magnetoresistive read head of claim 11, wherein the first bias electrode is made of a material selected from the group consisting of Rh, Ti, CoPt, CoCrPt, Cr, NiPd, NiCu, Au, Pt, Pd, V, Ta, and alloys thereof.

17. (Withdrawn) The magnetoresistive read head of claim 11, wherein the magnetoresistive stack is a tunneling magnetoresistive stack including two sensing layers with a tunnel barrier positioned therebetween.

18. (Withdrawn) The magnetoresistive read head of claim 17, wherein the tunnel barrier is made of a semiconductive material selected from the group consisting of GaP, AlP, ZnSe, AlAs, CdS, CdSe, AlSb, ZnTe, CdTe, and alloys thereof.

19. (Withdrawn) The magnetoresistive read head of claim 17, wherein the tunnel barrier is a dielectric barrier made of an oxide compound having a negative heat of formation.

20. (Withdrawn) The magnetoresistive read head of claim 17, further comprising:

one or more semiconductive current channeling layers positioned within the magnetoresistive stack.

21. (Withdrawn) The magnetoresistive read head of claim 20, wherein the one or more semiconductive current channeling layers are made of a semiconductive material selected from the group consisting of GaP, AlP, ZnSe, AlAs, CdS, CdSe, AlSb, ZnTe, CdTe, and alloys thereof.

22. (Withdrawn) The magnetoresistive read head of claim 17, wherein the sensing layers are made of a magnetic semiconductive material.

23. (Withdrawn) The magnetoresistive read head of claim 17, wherein the sensing layers are made of a half-metallic ferromagnetic material selected from the group consisting of CrO_2, CoTiO, ZnCoO, a Heusler alloy, Fe_3O_4, a Mn oxide compound with a perovskite structure, and a Mn nitride compound.

24. (Withdrawn) The magnetoresistive read head of claim 11, wherein the magnetoresistive stack is a giant magnetoresistive stack including two sensing layers with a conducting spacer positioned therebetween.

25-26. (Canceled)

27. (Previously presented) A magnetic sensor comprising:

a sensor stack; and

at least one electrode configured to generate an electric field generally perpendicular to a direction of sense current flow through the sensor stack to produce a charge carrier-depleted region in the magnetic sensor that confines the sense current to a smaller area in the magnetic sensor.

28. (Previously presented) The magnetic sensor of claim 27, wherein the at least one electrode comprises two bias electrodes disposed on opposing sides of the sensor stack such that an electrical width of the sensor stack is a function of a bias voltage applied to the two bias electrodes.

29. (Previously presented) The magnetic sensor of claim 27, wherein the at least one electrode comprises a bias electrode positioned such that an electrical height of the sensor stack is a function of a bias voltage applied to the bias electrode.

Evidence Appendix

1. Evidence entered by the Examiner and relied upon by the Appellant:

   None.

2. Evidence relied upon by the Examiner as to grounds of rejection to be reviewed on appeal:

   Kadokawa, U.S. Pat. No. 6,661,627

Related Proceedings Appendix

None.

Table of Authorities Appendix

None.